



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Syllabus for
B. Sc. III Biotechnology
Under
Faculty of Science and Technology
(As per NEP 2020)

With Effect From Academic Year 2026 - 2027

Syllabus for Bachelor of Science (B. Sc.) Part – III Biotechnology

As per the NEP 2020 guidelines this updated syllabus is prepared for first year undergraduate students of Biotechnology. At this level, to develop their interest towards Biotechnology as applied science and also to prepare them for the academic and industrial exposure simultaneously. Introduction of life science subjects will help to form a basic foundation of concepts for students. The interdisciplinary approach with vigor and depth is compatible to the syllabi of other universities, at the same time is not rigid for the students at first year of their graduation. The units in the syllabus are well defined with scope and the number of lectures. The Reference books are mentioned with relevance.

GENERAL OBJECTIVES

1. Construction and redesigning of the courses to suite local needs
2. More emphasis on applied aspects of biotechnology
3. To develop aptitude of students in the field of research
4. Enrichment of basic knowledge in areas of Biotechnology

GENERAL OUTCOMES

1. Graduate with proficiency in the biotechnology
2. Eligible to continue higher studies in the subject
3. Eligible to peruse post graduate study in abroad
4. Eligible to appear for the examination for a job in the government sector.

PROGRAM SPECIFIC OBJECTIVES

1. The students are expected to understand the fundamentals, principles, concept and recent developments in Biotechnology.
2. The practical course is framed in relevance with theory courses to improve understanding of various concepts in biotechnology.
3. It is expected to inspire and boost interest of students in Biotechnology.
4. To enrich students' knowledge and train them in various branches of Biotechnology.

PROGRAM SPECIFIC OUTCOMES

1. Understand basics of Biotechnology

2. Learn, design and perform experiments in the labs to demonstrate the concepts, principles and theories learnt in the classroom
3. Develop the ability to apply the knowledge acquired in classroom and laboratories to specific problems in theoretical and experimental biotechnology.
4. Identify the area of interest in the academic research and development.

DURATION: 01 year

PATTERN: Semester wise

MEDIUM OF INSTRUCTION: English

ELIGIBILITY OF STUDENTS: B. Sc II Pass

NUMBER OF STUDENTS: A batch shall consist of 60 students and additional 20 of seats will be allotted as per K. B. P. U., Satara norms.

ELIGIBILITY OF CORE TEACHERS: The eligibility of faculty as per rules and regulation of University Grant Commission (UGC).

ELIGIBILITY FOR PROFESSOR OF PRACTICE OR PROFESSIONAL

TRAINER: Any other eligibility as per the Guidelines and Regulations Passed by the Board of Concerned Studies, Academic Council of the College / University and Rules and Regulations of Karmaveer Bhaurao Patil University, Satara, Government of Maharashtra, and UGC norms.

SEMESTER, CREDIT FRAMEWORK NSQF LEVEL AND EXIT POINTS:

Sr. No	Semester	Year	Year	Credits	Level	Exit Points & Award
1	Sem. I & II	2026-27	1 Year	44	4 & 4.5	UG Certificate (Biotechnology)
2	Sem. III & IV	2027-28	1 Year	44	5	UG Diploma (Biotechnology)
3	Sem. V & VI	2028-29	1 Year	44	5.5	UG Degree (Biotechnology)
4	Sem. VII & VIII	2029-30	1 Year	44	6	UG Honours Degree/ Honours with Research (Biotechnology)
			Total	176		

STRUCTURE OF COURSE: CREDIT DISTRIBUTION

Sem (Level)	Courses			OE	VSC/ SEC	AEC/ VEC/ IKS	OJT/ FP/ CEP/ CC/ RP	Tot al Cre dits	
	Course I	Course II	Cours e III						
	Major Mandatory	Major Elective	-	-					
Sem V (5.5)	Major IX (2) Major X (2) Major XI (2) Major P V (2)	Major XII (Elect.) (2) Major P I (Elect.) (2)	-	-	VSC III (2) (P) Major specific)	AEC III (2) (English)	OJT (4) CEP (2)	22	UG Degree: 132
Sem VI (5.5)	Major XIII (2) Major XIV (2) Major XV (2) Major P VI (2)	Major XVI (Elect.) (2) Major P II (Elect.) (2)	-	-	VSC IV (2) (P) Major specific) SEC III (2) (P) (Major specific)	AEC III (2) (English)	FP (2) CC (2)	22	
Credits	16	08	-	-	06	04	10	44	
Total	48	24	12	08	14	16	10	132	Exit Option

Note:

VSC:-Vocational Skill Courses, SEC:-Skill Enhancement Course, AEC:-Ability Enhancement Course, FP:-Field Project, CC:-Co-curricular Course, OJT:-On Job Training, CEP:-Community Engagement Programme

STRUCTURE OF COURSE B. SC III AS PER NEP-2020 (2.0)

Semester V				
Sr. No.	Course	Course Code	Course Name	Credits
1	Major IX	BBTT 351	Basics in Genetic Engineering	02
2	Major X	BBTT 352	Animal Tissue culture	02
3	Major XI	BBTT 353	Bio - entrepreneurship	02
4	Electives XII	BBTT 354 E1	Industrial Biotechnology	02
		BBTT 355 E2	Bio-Nanotechnology	
5	Major Lab V	BBTP 356	Techniques in Genetic Engineering, Animal Tissue culture and Bio-entrepreneurship	02
6	Elective Lab I	BBTP 357	Techniques in Industrial Biotechnology (Elective Lab I)	02
			Laboratory Exercise in Bio-Nanotechnology (Elective Lab II)	
7	AEC III	BBTT AEC III	English for communication-III	02
8	VSC III	BBTP VSC III	Lab exercise based on Biotechnology and Business management in nursery	02
9	CEP I	BBTP CEP I	Community Engagement Programme in Biotechnology	02
10	OJT I	BBTP OJT I	On Job Training in Biotechnology I	04
			Total	22
Semester VI				
Sr.	Components		Course	Credits
1	Major XIII	BBTT 361	Advances in Genetic Engineering	02
2	Major XIV	BBTT 362	Food and Microbial Biotechnology	02
3	Major XV	BBTT 363	Computational Biology	02
4	Electives XVI	BBTT 364 E 1	Application of Biotechnology in Agriculture and Health	02
		BBTT 365 E 2	IPR, Bioethics and Quality Management	
5	Major Lab VI	BBTP 366	Techniques in Advances in Genetic Engineering, Food and Microbial biotechnology and computational Biology	02
6	Elective Lab II	BBTP 367	Laboratory exercise in Applications of Biotechnology in Agriculture and Health (Elective Lab I)	02
			Techniques in Application of Biotechnology in IPR, Bioethics and Quality Management (Elective Lab II)	
7	AEC IV	BBTT AEC IV	English for communication-IV	02
8	VSC IV	BBTP VSC IV	Biofertilizer and Biopesticide technology	02
9	SEC III	BBTP SEC III	Instrumentation and techniques in biotechnology	02
10	CC I	BBTP CC I	Co-Curricular course	02
11	FP I	BBTP FP I	Field Project in Biotechnology	02
			Total	22
EXIT OPTION: Award of UG Degree in Major with 132 credits OR Continue with Major & Minor.				

EVALUATION STRUCTURE

Semester V

Vertical	Course Category	Course Code	Internal Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
Major Mandatory	T	BBTT 351	10	10	10	30	50	02
	T	BBTT 352	10	10	10	30	50	02
	T	BBTT 353	10	10	10	30	50	02
	P	BBTP 356	20 (student performance and attendance, journal, viva)			30	50	02
Major Elective (1 Theory Papers Out of 2)	T	BBTT 354	10	10	10	30	50	02
	T	BBTT 355	10	10	10	30	50	02
	P	BBTP 357	20 (student performance and attendance, journal, viva)			30	50	02
AEC	T	AEC III	10	10	10	30	50	02
VSC	P	BBTP VSC III	20			30	50	02
CEP	P	BBTP CEP I	20			30	50	02
OJT	P	BBTP OJT I	40			60	100	04
Total							550	22

Semester VI

Vertical	Course Category	Course Code	Internal Evaluation			ESE	Total Marks	Credits
			CCE-I	CCE-II	CCE-III			
Major Mandatory	T	BBTT 361	10	10	10	30	50	02
	T	BBTT 362	10	10	10	30	50	02
	T	BBTT 363	10	10	10	30	50	02
	P	BBTP 366	20			30	50	02
Major Elective (1 Theory Papers Out of 2)	T	BBTT 364	10	10	10	30	50	02
	T	BBTT 365	10	10	10	30	50	02
	P	BBTP 367	20 (student performance and attendance, journal, viva)			30	50	02
AEC	T	AEC IV	10	10	10	30	50	02
VSC	P	BBTP VSC IV	25			25	50	02
SEC	P	BBTP SEC III	20 (student performance and attendance, journal, viva)			25	50	02
CC	T	BBTP CC I	10	10	10	30	50	02
FP	P	BBTP FP I	25			25	50	02
Total							550	22

Abbreviations: DSC: Discipline Specific Course; DSE: Discipline Specific Elective; CCE: Continuous Comprehensive Examination; AEC: Ability Enhancement Course; VSC: Vocational Skill Course; SEC: Skill Enhancement Course; OJT: On Job Training; FP: Field Project; CEP: Community Engagement Program; CC: Co-curricular Course; T: Theory; P: Practical

OTHER FEATURES:

A) LIBRARY:

Reference books, Textbooks, journals, and Periodicals are available in Institute and Departmental Library.

(Separate reference lists are attached along with the respective course syllabus)

B) EQUIPMENT:

a) Computer, LCD projector, visualizer, smart board

b) Laboratory Equipment:

1. Atomic Absorption Spectrometer
2. Autoclave Vertical
3. Bacteriological Incubator
4. Binocular Research Microscope CX 21i
5. BOD Incubator
6. Centrifuge Remi R-4C
7. COD refluxing unit
8. Colorimeter
9. Combined pH and Conductivity Meter
10. Compound Microscope
11. Conductivity Meter
12. Deep freezer
13. Dissection microscope
14. Distillation assembly
15. Flame Photometer
16. Hemocytometer
17. Horizontal Electrophoresis unit
18. Horizontal Laminar Airflow
19. Hot Plate
20. Lux Meter
21. Microcentrifuge
22. Microscope camera device
23. Microwave Oven
24. MiniCentrifuge Remi
25. Mixer
26. pH Meter
27. Refractometer
28. Refrigerator
29. Rotary Shaker
30. Sonicator Waterbath



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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester - V

Type : Major IX

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBT 351: Basics in Genetic Engineering

Course Objectives: Student should be able to...

- 1) learn molecular tools in r-DNA technology
- 2) know various vectors used in genetic engineering
- 3) acquire knowledge of molecular Tools and Primer designing
- 4) understand DNA Sequencing, Blotting technique and its application

Course Outcomes: Students will be able to...

- 1) discuss enzymes and vectors used in genetic engineering.
- 2) demonstrate various cloning methodologies, gene libraries.
- 3) explain PCR and its applications in genetic engineering.
- 4) interpret sequencing methods and blotting techniques.

Module	Title and Contents	Hrs
Module -1	Molecular Tools in r-DNA technology : 1.1. Introduction, Scope and importance 1.2. Enzymes and its application -Restriction enzymes- types (I, II, III), 1.3. Nomenclature, recognition sequences, cleavage patterns, modification of cut ends (linkers and adaptors), application, 1.4. Enzymes in r-DNA technology: Alkaline phosphatases, DNA ligases, Polymerases- E-coli DNA Polymerase, Taq DNA Polymerases, Klenow Fragment, Reverse Transcriptase, Polynucleotide kinase.	6
Module -2	Cloning Vectors 2.1. Introduction, Properties of good vectors, Properties of good host, Cloning & expression vectors 2.2. Types-E.coli vector: plasmid (pBR 322 and pUC18), Bacteriophage vectors (λ phage vector and M13 vector), 2.3. Cosmid vector, Phagemid vector (pBlue script II KS/SK), Yeast vector, YAC 2.4. Animal vectors (Simian Virus 40), Plant vector (Ti plasmid, Shuttle vector, Selection of recombinant vector.	8
Module -3	Nucleic Acid Hybridisation : 3.1 Nucleic Acid and plasmid purification, Probe Preparation, 3.2 Preparation, Methods of labelling probes: Radio labelling – Nick translation, End labelling, Primer extension 3.3 Non Radiolabelling – Biotin, dioxygenin, fluorescent dyes, FISH 3.4 Applications of probes.	8
Module -4	Sequencing Methods and Blotting Techniques:	8

	4.1 DNA Sequencing: Maxam Gilbert method, Sanger Coulson method and Automated DNA sequencing 4.2 Blotting technique: Southern Blotting, Northern Blotting., Western blotting, Dot Blot Technique.	
Reference Books:- 1) Singh, B. D. <i>Biotechnology, Expanding Horizons</i> . 5th ed. New Delhi: Medtech Science Press, 2023. 2) Dubey, R. C. <i>Advanced Biotechnology</i> . New Delhi: S. Chand & Company, 2014. 3) Nicholl, D. S. T. <i>An Introduction to Genetic Engineering</i> . 3rd ed., South Asian ed. Cambridge: Cambridge University Press, 2010. 4) Rastogi, Smita, and Neelam Pathak. <i>Genetic Engineering</i> . New Delhi: Oxford University Press, 2009. 5) Howe, C. <i>Gene Cloning and Manipulation</i> . 2nd ed. Cambridge: Cambridge University Press, 2007. 6) Lewin, Benjamin. <i>Genes IX</i> . Sudbury, MA: Jones and Bartlett Publishers, 2007. 7) Glick, B. R., and J. J. Pasternak. <i>Molecular Biotechnology: Principles and Applications of Recombinant DNA</i> . 3rd ed. Washington, D.C.: American Society for Microbiology, 2002. 8) Primrose, Sandy B., Richard Twyman, and Bob Old. <i>Principles of Gene Manipulation: An Introduction to Genetic Engineering</i> . 6th ed. Oxford: Wiley-Blackwell, 2001. 9) Sambrook, Joseph, and David Russell. <i>Molecular Cloning: A Laboratory Manual</i> . Vols. I, II, III. 3rd ed. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2000. 10) Setlow, Jane K., ed. <i>Genetic Engineering: Principles and Methods</i> . Vol. 13. [Place of publication not provided], [Publisher not provided]. (Year not provided, so placed last.)		
Evaluation Pattern:60:40		
Total Marks: 50		
Internal Continuous Evaluation: (20 Marks) CCE I – (10 marks) Home Assignment CCE II- (10 marks) Short long answer questions test/ open book test/ Quiz/ Case Study/ Book Review/ field work/ Industry visit CCE III – (10 marks) MCQ test (Best two out of Three CCE)	End Semester Examination: (30 Marks) Question -1 Question -2 Question -3	



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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester - V

Type : Major X

Marks: 50

Credits : 2

From: A. Y. 2025-26

Name of the Course: BBT 352: Animal Tissue Culture

Course Objectives: Student should be able to...

- 1) describe the organization and setup of an animal tissue culture laboratory.
- 2) explain the basic concepts, physicochemical requirements, and techniques of animal tissue culture.
- 3) differentiate the various types of animal cell cultures.
- 4) discuss the applications of animal tissue culture in research and biotechnology.

Course Outcomes: Students will be able to...

- 1) demonstrate basic knowledge of animal tissue culture.
- 2) analyze knowledge about laboratory organization and safety.
- 3) interpret techniques of preparation of ATC media.
- 4) apply the ethics of animal tissue culture techniques.

Module	Title and Contents	Hrs
Module -1:	Introduction to Animal Tissue Culture 1.1. History and Introduction of Animal Cell culture. 1.2. Requirements of Animal cell culture- substrate for cell growth, Equipment's required for animal cell culture (Laminar air flow, CO2 incubator, Centrifuge, Inverted microscope), 1.3. Sterilization of Glassware's, Equipment's & culture media - Glassware sterilization, reagent and media sterilization. 1.4. Culture media- Natural media, synthetic media, media constituent, physicochemical properties of media.	7
Module -2:	Biology, Characterization and growth cultured cells 2.1. Cultured cells- Characteristics of cultured cells, cell adhesion, cell proliferation, cell differentiation, 2.2. Characterization of cultured cells- Morphology of cells, species of origin of cells, Identification of tissue of origin, transformed cells, Identification of specific cell lines. 2.3. Measurement of growth parameters of cultured cells- Growth cycle of cultured cells, plating efficiency of cultured cells 2.4. Cell synchronization- Cell separation by physical means, cell separation by chemical blockade 2.5. Senescence and apoptosis- Cellular senescence, Measurement of senescence.	8
Module -3:	Basic Techniques and Scale-Up Methods in Mammalian Cell Culture 3.1. Basic technique of mammalian cell culture- Isolation of tissue, disaggregation of tissue, measurement of viability, primary cell culture, Cell lines, Maintenance of cell culture, Subculture.	7

	3.2. Scale up of Animal cell culture-Scale up in suspension-stirrer culture, continuous flow culture, Airlift fermenter culture Scale up in monolayer-Roller bottle culture, multi surface culture, multiarray disks, and tubes, Micro carrier culture.	
Module -4:	Cell Culture Techniques 4.1. Organ and Histotypic culture-Types and maintenance of organ culture, Histotypic culture, Stem cell cultures. 4.2. Cell storage and distribution: a. Cryopreservation b. Cell repositories 4.3. Applications of cell culture-In transplantation, and tissue engineering, monoclonal antibodies production, ethics and morality, 4.4. production of vaccine via animal cell culture e.g. COVID-19.	8

Reference Books:-

- 1) World Health Organization. WHO Guidelines on Cell Culture and Vaccine Production . Geneva: WHO, 2020.
- 2) Freshney R. Ian. Culture of Animal Cells: A Manual of Basic Technique and Specialized applications . 7th ed. Hoboken, NJ: John Wiley & Sons, 2016.
- 3) Singh B. D.. Biotechnology: Expanding Horizons . New Delhi: Kalyani Publishers, 2015.
- 4) American Type Culture Collection. ATCC Animal Cell Culture Guide: Tips and Techniques . Manassas, VA: ATCC, 2014
- 5) Gupta P. K.. Elements of Biotechnology . 2nd ed. New Delhi: Rastogi Publications, 2010.
- 6) Amanda Capes-Davis, and John R. W. Masters. Animal Cell Culture: Essential Methods. Chichester: John Wiley & Sons, 2009.
- 7) Doyle R., and Griffiths J., eds. Cell and Tissue Culture: Laboratory Procedures . Chichester: John Wiley & Sons, 1998.
- 8) Morgan S. J., and Darling D. Animal Cell Culture: A Practical Approach . Oxford: Oxford University Press, 1993.
- 9) Gordon Sato. "Serum-Free Cell Culture." Annual Review of Biochemistry 55 (1986): 435–462.
- 10) Paul J. Cell and Tissue Culture . 5th ed. Edinburgh: Churchill Livingstone, 1975.

Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: (20 Marks) CCE I – (10 marks) Home Assignment CCE II- (10 marks) Short long answer questions test/ open book test/ Quiz/ Case Study/ Book Review/ field work/ Industry visit CCE III – (10 marks) MCQ test (Best two out of Three CCE)	End Semester Examination: (30 Marks) Question -1 Question -2 Question -3
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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Biotechnology	
	Programme: B.Sc.	Semester - V
	Type : Major XI	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBTT 353: Bio entrepreneurship		

Course Objectives: Students should be able to...

- 1) describe the role of entrepreneurship and small businesses in economic development.
- 2) organize small business operations using principles of management.
- 3) develop financial plans and apply control techniques for small businesses.
- 4) evaluate different forms of business ownership to determine the most suitable structure.

Course Outcomes: Students will be able to...

- 1) design a comprehensive business plan for a small-scale enterprise.
- 2) interpret the fundamental principles of management and administration in small businesses.
- 3) differentiate the legal forms of business organizations and outline the procedures for registration with relevant agencies.
- 4) evaluate key concepts and opportunities in bio-entrepreneurship.

Module	Title and Contents	Hrs
Module -1:	An Overview of Entrepreneurs and Entrepreneurship 1.1. Introduction and concept of Entrepreneurs and Entrepreneurship 1.2. Basic principles and practices of management- Definition, Organization types, coordination, control and decision making in management 1.3. Applications of Entrepreneurs and Entrepreneurship.	8
Module -2:	Entrepreneurial Traits and Market Insights in Biotechnology 2.1. Characteristics for being an entrepreneur in biotechnology, Case studies of successful and unsuccessful bio-entrepreneurs 2.2. Core concept of Market: Identification and evaluation of market potential of various bio-entrepreneur sectors.	7
Module -3:	Types of Enterprises and Ownership Structures in Biotechnology 3.1. Role of small enterprises in economic development. 3.2. Types of Enterprises and Ownership Structure: small scale, medium scale and large scale enterprises. 3.3. Forms of business ownership: Proprietorship, partnership, limited companies, and cooperatives—formation, capital structure, and sources of finance.	8
Module -4:	Government Support and Key Factors in Bio-entrepreneurship 4.1. Role of government, financial institutions, and support schemes in fostering bio-entrepreneurship.	7

	4.2. Factors affecting biotech business: Finance, infrastructure, equipment, manpower, resources, project planning, project location, end product, and quality issues.	
Reference Books:- 1) Hisrich, Robert D., Michael P. Peters, and Dean A. Shepherd. Entrepreneurship. 10th ed. New York: McGraw-Hill Education, 2017. 2) Balasubramanian, P. Biotechnology and Entrepreneurship: Creating BioWealth. New Delhi: CRC Press India, 2015. 3) Shimasaki, Craig D. Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech Companies. Amsterdam: Academic Press, 2014.: Starting, Managing, and Leading Biotech Companies. Amsterdam: Academic Press 4) Blundel, Richard, and Nigel Lockett. Exploring Entrepreneurship: Practices and Perspectives. Oxford: Oxford University Press, 2011. 5) Mellor, Robert. Entrepreneurship for Everyone: A Student Textbook. London: Sage Publications Ltd., 2009. 6) Mehta, Shreefal S. Commercializing Successful Biomedical Technologies. Cambridge: Cambridge University Press, 2008. 7) Patzelt, Holger, and Thomas Brenner, eds. Handbook of Bioentrepreneurship. Berlin: Springer, 2008. 8) Kumar, S. Anil. Entrepreneurship Development. New Delhi: New Age International (P) Ltd. Publishers, 2003. 9) Entrepreneurial Development: Text and Cases. New Delhi: Sultan Chand & Sons, 1992. 10) Jogdand, S. N. Entrepreneurship and Business of Biotechnology. Mumbai: Himalaya Publishing House.		
Evaluation Pattern:60:40		
Total Marks: 50		
Internal Continuous Evaluation: (20 Marks) CCE I – (10 marks) Home Assignment CCE II- (10 marks) Short long answer questions test/ open book test/ Quiz/ Case Study/ Book Review/ field work/ Industry visit CCE III – (10 marks) MCQ test (Best two out of Three CCE)	End Semester Examination: (30 Marks) Question -1 Question -2 Question -3	

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	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Biotechnology	
	Programme: B.Sc.	Semester - V
	Type : Elective I XII	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBTT 354: Industrial Biotechnology (Elective I)		
Course Objectives: Student should be able to... 1) describe the fundamental concepts and scope of industrial biotechnology. 2) identify the microorganisms used in industrial production processes. 3) examine the design, types, and working principles of bioreactors and fermenters. 4) explain the upstream and downstream processing techniques involved in bioproduct manufacturing.		
Course Outcomes: Students will be able to... 1) interpret the scope and applications of industrial biotechnology. 2) analyze industrial bioproduct production processes. 3) differentiate industrially important microorganisms. 4) apply upstream and downstream processing techniques.		
Module	Title and Contents	Hrs
Module -1:	Introduction to Industrial Biotechnology: 1.1. Concept and range of fermentation technology, Types of fermentations (Batch, continuous, dual, multiple), Concept of solid state & submerged fermentation. 1.2. Microbial metabolic products- Primary & Secondary products. Basic design of fermenter- Components of fermenter and their functions, Fermentation economics, 1.3. Types of fermenters-- Stirred tank fermenter, Airlift fermenter, Tower fermenter, Tubular fermenter. Aeration and agitation of fermentation broth.	8
Module -2:	Microbial Screening, Scale up and strain improvement 2.1. Selection strategy and techniques, Primary and secondary screening, Primary screening of antibiotic, organic acid, vitamin C and amino acid, Secondary screening of antibiotic producers. 2.2. Scale up of fermentations. Production of Biogas, Microbial insecticides - <i>Bacillus thuringensis</i> . 2.3. Strain improvement concept, Maintenance and preservation of industrially important cultures.	7
Module -3:	Fermentation Media and sterilization 3.1. Composition of typical fermentation media. Criteria for typical fermentation medium Types of fermentation media, 3.2. General role of media components water, carbon source, nitrogen source, minerals, precursors, growth factors, buffers, antifoams, oxidation-reduction	8

	potentials, inducers, inhibitors. 3.3. Sterilization of media, Indicator microorganism, Sterilization of media- In situ and Ex situ sterilization, Batch and continuous sterilization, equipment used, Filter sterilization.	
Module -4:	Downstream Process and Product Recovery 4.1. Downstream Processes in fermentation and bioprocess technology Solid and liquid separation. 4.2. Flocculation and Flotation, filtration and centrifugation - Cell disruption by solid and liquid shear, ultra-sonication, enzyme action and mechanical disruption, Product recovery and purification principle Precipitation, Crystallization. 4.3. Liquid-Liquid extraction, Distillation (Fractional and Steam), Evaporation, Chromatographic separation (Principles), Adsorption and concentration, Membrane filtration, Lyophilization, spray drying.	7
Reference Books:- 1) Kelsall, Robert W., Ian W. Hamley, and Mark Geoghegan. Nanotubes and Nanomaterials: Synthesis, Properties, and Applications. Oxford: Oxford University Press, 2023. 2) Das, Debabrata, and SoumyaPandit. Industrial Biotechnology: Sustainable Production and Use of Biofuels and Biochemicals. Boca Raton, FL: CRC Press, 2021. 3) Wittmann, Christoph, and James C. Liao, eds. Industrial Biotechnology: Sustainable Growth and Economic Success. Weinheim: Wiley-VCH, 2017. 4) Kulkarani, S. K. Nanotechnology: Principles and Practices. 3rd ed. New Delhi: Capital Publishing, 2014. 5) Doran, Pauline M. Bioprocess Engineering Principles. 2nd ed. Amsterdam: Academic Press, 2012. 6) Moo-Young, Murray, ed. Comprehensive Biotechnology. 2nd ed. Oxford: Elsevier, 2011. 7) Singh, Ratneshwar, and Ashok Pandey. Biotechnology for Agro-Industrial Residues Utilization: Utilization of Agro-Residues. Dordrecht: Springer, 2009. 8) Zhang, Jin Zhong. Optical Properties and Spectroscopy of Nanomaterials. Singapore: World Scientific Publishing (WSPC), 2009. 9) John Wiley & Sons, Inc. An Introduction to Nanoscience and Nanotechnology. Hoboken, NJ: John Wiley & Sons, 2008. 10) Callister, William D., Jr., and David G. Rethwisch. Materials Science and Engineering: An Introduction. Hoboken, NJ: John Wiley & Sons, 2000.		
Evaluation Pattern:60:40		
Total Marks: 50		
Internal Continuous Evaluation: (20 Marks) CCE I – (10 marks) Home Assignment CCE II- (10 marks) Short long answer questions test/ open book test/ Quiz/ Case Study/ Book Review/ field work/ Industry visit CCE III – (10 marks) MCQ test (Best two out of Three CCE)	End Semester Examination: (30 Marks) Question -1 Question -2 Question -3	

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	Board of Studies in Biotechnology	
	Programme: B.Sc.	Semester - V
	Type : Elective II XII	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBTT 355: Bio-Nanotechnology (Elective II)		
Course Objectives: Student should be able to...		
1) define and explain the fundamental concepts of the Nano science. 2) provide a comprehensive understanding of nanoparticles, nanowires. 3) explore the integration of biomolecules as nanostructures. 4) explain physical, chemical methods for synthesis of nanostructures.		
Course Outcomes: Students will be able to...		
1) identify and explain methods used to synthesize nanostructures using physical, chemical, and biological techniques. 2) analyze the physicochemical properties of nanomaterials using appropriate characterization tools. 3) apply nanobiotechnology concepts to develop biosensors, drug delivery systems, and therapeutic platforms. 4) understand and evaluate the interaction of functionalized nanomaterials with biological molecules and systems.		
Module	Title and Contents	Hrs
Module -1:	Introduction to Nano world, Nano science and Nanotechnology 1.1. Nanoparticles, nanowires, thin films Applications in various fields viz.Physical and Chemical, Materials, life sciences. 1.2. Nanobiotechnology: Introduction, Biomolecules as nanostructures and their applications in nanotechnology viz. Biosensors, 1.3. separation of cells and cell organelles, cancer therapy, gene therapy etc.	8
Module -2:	Synthesis of nanostructure 2.1. Physical methods– Mechanical methods, methods based on evaporation, sputter deposition, chemical vapour deposition (CVD), and electric arc deposition. 2.2. Chemical methods: Synthesis of nanoparticles by colloidal route, micro emulsion, sol gel method, chemical precipitation, pyrolysis. 2.3. Biological methods: Synthesis using microorganism, synthesis using plant extracts, use of proteins and template like DNA.	7
Module -3:	Properties and Characterization of nanomaterial 3.1. Optical (UV-Vis / Fluorescence), X-ray diffraction, 3.2. Imaging and size (Electron microscopy, Light scattering, Zetapotential), 3.3. Surface and composition (ECSA, EDAX, AFM/STM), 3.4. Magnetic, Electrical and Electrochemical.	8
Module -4:	Functionalization of Nanoparticles for biological applications 4.1. Proteins- Lipids-RNA-DNA, Protein targeting –small molecules /	7

	Nanomaterial-Protein interaction. 4.2. Nanomaterial-cell interaction – manifestation of surface modification (polyvalency), 4.3. Lipid nanoparticles for Drug Delivery, Inorganic Nanoparticles for Drug Delivery, metal / Metallic oxide nanoparticles (antibacterial/ antifungal/antiviral).	
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Reference Books:-

- 1) Bhushan, Bharat. Springer Handbook of Nanotechnology. 4th ed. Cham: Springer, 2017.
- 2) Kulkarni, Sulabha K. Nanotechnology: Principles and Practices. Revised ed. New Delhi: Capital Publishing Company, 2009.
- 3) Hornyak, Gabor L., H.F. Tibbals, Joydeep Dutta, and John J. Moore. 2008. Introduction to Nanoscience and Nanotechnology.
- 4) Shoseyov, Oded, and Ilan Levy, eds. Nanobiotechnology: BioInspired Devices and Materials of the Future. Totowa, NJ: Humana Press, 2008.
- 5) Papazoglou, Elisabeth S., and Aravind Parthasarathy. BioNanotechnology. 1st ed. San Rafael, CA: Morgan & Claypool Publishers, 2007.
- 6) Sharon, Maheshwar, and Madhuri Sharon. Nano Forms of Carbon and Its Applications. Manad Nanotech Pvt. Ltd., 2007.
- 7) Kannangara, Kamali, Chris T. Smith, Michelle Simmons, and Barry Raguse. Nanotechnology: Basic Science and Emerging Technologies. Amsterdam: Overseas Press, 2005.
- 8) Goodsell, David S. Bionanotechnology: Lessons from Nature. Hoboken, NJ: John Wiley & Sons, Inc., 2004.
- 9) Niemeyer, Christof M., and Chad A. Mirkin, eds. Nanobiotechnology. Weinheim: Wiley-VCH, 2004.
- 10) Strosio, Michael A., and Mitra Dutta. Biological Nanostructures and Application of Nanostructures in Biology. Dordrecht: Kluwer Academic Publishers, 2004.

Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: (20 Marks) CCE I – (10 marks) Home Assignment CCE II- (10 marks) Short long answer questions test/ open book test/ Quiz/ Case Study/ Book Review/ field work/ Industry visit CCE III – (10 marks) MCQ test (Best two out of Three CCE)	End Semester Examination: (30 Marks) Question -1 Question -2 Question -3
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Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester - V

Type : Major P V

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBTP 356 :Techniques in Genetic Engineering, Animal Tissue culture and Bio-entrepreneurship

Course Objectives: Student should be able to...

- 1) learn basic molecular biology techniques.
- 2) develop skills in animal cell culture.
- 3) understand lab safety and sterilization methods.
- 4) introduce biotech product development and entrepreneurship.

Course Outcomes: Students will be able to...

- 1) perform dna isolation, ligation, and analysis techniques.
- 2) handle and maintain animal cell cultures.
- 3) apply aseptic and lab management practices.
- 4) design and present a biotech product or startup idea.

Sr. No.	Name of the Practical	Hrs
1.	Calculation of molecular size of digested DNA	60
2.	Construction of restriction map of plasmid DNA	
3.	Plasmid extraction from Bacterial cells	
4.	Ligation of DNA	
5.	Purification of DNA fragment from agarose gel	
6.	Blotting technique DNA/RNA	
7.	Laboratory organization for Animal tissue culture	
8.	Preparation and sterilization of culture media	
9.	Preparation of Serum.	
10.	viable cell count analysis of cells	
11.	Aseptic transfer techniques in cell culture	
12.	Design of a Logo and Brand Name for a Bioproduct	
13.	Study of Product Costing and Pricing Strategies	
14.	Design and Development of Product Advertisement	
15.	Presentation of a Biotech Startup Idea.	

Reference Books:-

- 1) Hisrich, Robert D., Michael P. Peters, and Dean A. Shepherd. Entrepreneurship. 10th ed. New York: McGraw-Hill Education, 2017.
- 2) Brown, T. A. Gene Cloning and DNA Analysis. 7th ed. Chichester: Wiley-Blackwell, 2016.
- 3) Freshney, R. Ian. Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications. 7th ed. Hoboken, NJ: John Wiley & Sons, 2016.
- 4) Shimasaki, Craig D. Biotechnology Entrepreneurship: Starting, Managing, and Leading Biotech

Companies. Amsterdam: Academic Press, 2014.

- 5) Green, Michael R., and Joseph Sambrook. Molecular Cloning: A Laboratory Manual. 4th ed. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2012.
- 6) Wilson, Keith, and John Walker. Principles and Techniques of Biochemistry and Molecular Biology. 7th ed. Cambridge: Cambridge University Press, 2010.
- 7) Primrose, S. B., and Richard M. Twyman. Principles of Gene Manipulation and Genomics. 7th ed. Oxford: Blackwell Publishing, 2006.
- 8) Sambrook, Joseph, and David W. Russell. Molecular Cloning: A Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2001.
- 9) Masters, John R. W. Animal Cell Culture: A Practical Approach. Oxford: Oxford University Press, 2000.
- 10) Doyle, A., and J. B. Griffiths. Cell and Tissue Culture: Laboratory Procedures. Chichester: John Wiley & Sons, 1998.

Evaluation Pattern:60:40

Total Marks: 50

Internal Continuous Evaluation: (20 Marks)

Student Attendance and Performance –
10Marks

Journal and Viva voce – 10 Marks

End Semester Practical Examination: (30 marks)

Question -1

Question -2

Question -3

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology		
	Yashavantrao Chavan Institute of Science, Satara		
	Board of Studies in Biotechnology		
	Programme: B.Sc.	Semester - V	
	Type : Elective Lab I	Marks: 50	
	Credits : 2	From: A. Y. 2026-27	
Name of the Course: BBTP 357: Techniques in Industrial Biotechnology (Elective Lab I)			
Course Objectives: Student should be able to...			
1) understand the principles of industrial microbiology and biotechnology.			
2) learn techniques for screening and isolation of industrially important microorganisms from natural sources.			
3) develop skills in primary and secondary screening methods (crowded plate, replica plate techniques).			
4) learn strain improvement techniques such as uv mutagenesis and mutant selection.			
Course Outcomes: Students will be able to			
1) isolate and identify industrially important microorganisms from environmental samples.			
2) perform screening techniques to detect enzyme and metabolite-producing microbes.			
3) carry out fermentation processes for production of alcohol, organic acids, enzymes, and biopolymers.			
4) apply strain improvement methods to enhance microbial productivity.			
Sr. No.	Name of the Practical	Hrs	
1.	Primary screening of antibiotic producers by crowded plate technique	60	
2.	Primary screening of amylase producers by Replica Plate technique		
3.	Production of alcohol and estimation by specific gravity method		
4.	Production of sauerkraut		
5.	Production of wine		
6.	Screening and Isolation of Industrially Important Microorganisms from Soil Samples		
7.	Selection and screening of mutants		
8.	Demonstration of Bioreactor Operation and Parameter Monitoring		
9.	Production of Citric Acid Using <i>Aspergillus niger</i>		
10.	Strain Improvement of <i>E. coli</i> by UV Mutagenesis for Enhanced Enzyme Production		
11.	Production of Lactic Acid Using <i>Lactobacillus</i> Species		
12.	Solid State Fermentation for Enzyme Production		
13.	Bioplastic Production Using <i>Pseudomonas</i> Species		
14.	Effect of pH and Temperature on Enzyme Activity		
15.	Industrial Visit to fermentation industry		
Reference Books:-			

- 1) Patel, A. H. Industrial Microbiology. 2nd ed. New Delhi: Macmillan India Ltd., 2020.
- 2) Casida, L. E. Industrial Microbiology. Reprint ed. New Delhi: New Age International Publishers, 2019.
- 3) Crueger, Wolfgang, and Anneliese Crueger. Biotechnology: A Textbook of Industrial Microbiology. 3rd ed. New Delhi: Panima Publishing, 2017.
- 4) Stanbury, Peter F., Stephen J. Hall, and A. Whitaker. Principles of Fermentation Technology. 3rd ed. Oxford: Elsevier, 2016.
- 5) Dubey, R. C. A Textbook of Biotechnology. 6th ed. New Delhi: S. Chand & Company Ltd., 2014.
- 6) Moo-Young, Murray, ed. Comprehensive Biotechnology. 2nd ed. Vol. 3. Oxford: Pergamon Press, 2011.
- 7) Pandey, Ashok, Carlos Ricardo Soccol, and Christian Larroche, eds. Current Developments in Solid-State Fermentation. New Delhi: Springer, 2008.
- 8) Glazer, Alexander N., and Hiroshi Nikaido. Microbial Biotechnology: Fundamentals of Applied Microbiology. 2nd ed. Cambridge: Cambridge University Press, 2007.
- 9) Satyanarayana, T., and Bhavdish Narain Johri, eds. Microbial Diversity: Current Perspectives and Potential Applications. New Delhi: I.K. International, 2005.
- 10) Waites, M. J., Neil L. Morgan, John S. Rockey, and Gary Higton. Industrial Microbiology: An Introduction. Oxford: Wiley-Blackwell, 2001.

Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: (20 Marks)

Student Attendance and Performance –
10Marks
Journal and Viva voce – 10 Marks

End Semester Practical Examination: (30 Marks)

Question -1
Question -2
Question -3



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester - V

Type : Elective Lab II

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBTP 357: Laboratory Exercise in Bio-Nanotechnology (Elective Lab II)

Course Objectives: Student should be able to...

- 1) understand spectroscopic and optical instrumentation
- 2) gain knowledge of advanced analytical tool.
- 3) understand the principles and techniques involved in the synthesis of nanoparticles
- 4) gain practical experience in the characterization of nanomaterials

Course Outcomes: Students will be able to...

- 1) analyze enzymatic decomposition of hydrogen peroxide and determine catalase activity.
- 2) estimate dna concentration and purity based on absorbance.
- 3) synthesize nanoparticles using various methods like the stöber method, green synthesis, and chemical method.
- 4) apply nanoparticle-based assays for environmental monitoring (e.g., heavy metal detection) and biomedical applications.

Sr. No.	Name of the Practical	Hrs
1.	Determination of minimum inhibitory concentration (MIC) of nanoparticles using broth dilution method.	60
2.	Comparison of antibacterial activity between silver and copper nanoparticles using agar well diffusion method.	
3.	Zone of inhibition analysis of plant-extract synthesized nanoparticles on gram-positive and gram-negative bacteria.	
4.	Effect of nanoparticle concentration on bacterial growth curve using spectrophotometry.	
5.	Assessment of antimicrobial activity using disk diffusion method	
6.	Preparation of silver nanoparticles using plant extracts (green synthesis).	
7.	Effect of pH on antibacterial efficacy of nanoparticles.	
8.	Observation of antibacterial activity of metal oxide nanoparticles.	
9.	Green synthesis of copper nanoparticles using leaf extracts.	
10.	Analysis of antibacterial properties using agar diffusion with metal nanoparticles.	
11.	Effect of Salt Concentration on Nanoparticle Stability	
12.	Synthesis of Nanoparticles by Chemical Precipitation Method	
13.	UV-Visible Spectral Analysis of Synthesized Nanoparticles	
14.	Study of Color Change in Nanoparticle Formation	
15.	Drying and Storage of Nanoparticles	

Reference Books:-

- 1) Crowther, John R. The ELISA Guidebook. 2nd ed. New York: Humana Press, 2009.
- 2) Papazoglou, Elisabeth S., and Aravind Parthasarathy. BioNanotechnology. 1st ed. San Rafael, CA: Morgan & Claypool Publishers, 2007.
- 3) Sharon, Maheshwar, and Madhuri Sharon. Nano Forms of Carbon and Its Applications. Manad Nanotech Pvt. Ltd., 2007.
- 4) Kannangara, Kamali, Chris T. Smith, Michelle Simmons, and Barry Raguse. Nanotechnology: Basic Science and Emerging Technologies. Amsterdam: Overseas Press, 2005.
- 5) Stroschio, Michael A., and Mitra Dutta. Biological Nanostructures and Application of Nanostructures in Biology. Dordrecht: Kluwer Academic Publishers, 2004.
- 6) Goodsell, David S. Bionanotechnology: Lessons from Nature. Hoboken, NJ: John Wiley & Sons, Inc., 2004.
- 7) Aebi, H. "Catalase in vitro." Methods in Enzymology 105 (1984): 121–126.
- 8) Ruck, J.A. "Chemical Methods for Analysis of Fruits and Vegetable Products." Summerland Research Station, Canada Department of Agriculture, 1963.
- 9) Miller, Glenn L. "Use of Dinitrosalicylic Acid Reagent for Determination of Reducing Sugar." Analytical Chemistry 31, no. 3 (1959): 426–428.
- 10) Arnon, D.I. "Copper Enzymes in Isolated Chloroplasts. Polyphenoloxidase in Beta vulgaris." Plant Physiology 24, no. 1 (1949): 1–15.

Evaluation Pattern:60:40**Total Marks: 50****Internal Continuous Evaluation: (20 Marks)**

Student Attendance and Performance –
10Marks
Journal and Viva voce – 10 Marks

End Semester Practical Examination: (30 Marks)

Question -1
Question -2
Question -3

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Biotechnology	
	Programme: B.Sc.	Semester-V
	Type :VSC III	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBTP VSC III: Lab exercise based on Biotechnology and Business management in nursery		

Course Objectives: Student should be able to...

- 1) impart practical knowledge of nursery establishment and plant propagation techniques.
- 2) develop skills in biotechnological applications for quality plant production
- 3) introduce nursery-based business planning, marketing, and financial management
- 4) prepare students for entrepreneurship and commercial nursery management

Course Outcomes: Students will be able to...

- 1) manage legal, financial, customer, and inventory aspects of nursery business
- 2) analyze and prepare business models for nursery enterprises
- 3) develop entrepreneurial skills for setting up a commercial nursery
- 4) apply practical nursery management techniques

Practical No.	List of Practical's	Hrs
1	Integrated nursery layout, irrigation, structures, and nursery bed management.	60
2	Cost-Benefit Analysis of Nursery Production	
3	Market Survey and Demand Forecasting for Nursery Plants	
4	Packaging and Labelling Techniques for Nursery Plants	
5	Study of Legal and Financial Requirements for Starting a Nursery	
6	Preparation of Advertisement and Promotion Plan for a Nursery	
7	Customer relationship management in nursery	
8	Online Marketing Strategies for Selling Nursery Plants	
9	Record Keeping and Inventory Management in Nursery Business	
10	Evaluation of Marketing Channels for Nursery	
11	Training Module Design for Nursery Staff and Workers	
12	Use of ICT Tools in Nursery Business Management	
13	Intellectual property rights in nursery	
14	Preparation of an Invoice and Billing System for Nursery Plan	
15	Role of Branding in Enhancing Nursery Business	

Hands on Training/Project/Industrial Visit/Case Study- ---- Hours

Reference Books:-

- 1) Dahama, A. K. Organic Farming for Sustainable Agriculture. Jodhpur: Agrobios (India), 2013.
- 2) Khanka, S. S. Entrepreneurship Development. New Delhi: S. Chand & Company Ltd., 2013.
- 3) Gupta, P. K. Plant Tissue Culture and Biotechnology. Meerut: Rastogi Publications, 2012.
- 4) Hartmann, H. T., D. E. Kester, F. T. Davies, and R. L. Geneve. Plant Propagation: Principles and

Practices. USA: Prentice Hall, 2011.

- 5) Kumar, N. Introductory Horticulture. Nagercoil: Rajalakshmi Publications, 2010.
- 6) Singh, J. S. Fundamentals of Horticulture. New Delhi: Kalyani Publishers, 2007.
- 7) Peter, K. V. Textbook of Horticulture. New Delhi: New India Publishing Agency, 2007.
- 8) Tandon, H. L. S. A Handbook of Soil, Plant and Water Analysis. New Delhi: Fertilizer Development and Consultation Organization, 2005.
- 9) Razdan, M. K. Introduction to Plant Tissue Culture. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd., 2003.
- 10) Bhojwani, S. S., and M. K. Razdan. Plant Tissue Culture: Theory and Practice. Amsterdam: Elsevier Science Publishers, 1996.

Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: (20 Marks)

Student Attendance and Performance –

10Marks

Journal and Viva voce – 10 Marks

End Semester Practical Examination: (30 Marks)

Question -1

Question -2

Question -3

AEC III- English for communication III

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Biotechnology	
	Programme: B.Sc.	Semester–V
	Type : CEP I	Marks: 50
	Credits : 2	From: A. Y. 2026-27
	Name of the Course: BBTP CEP I: Community Engagement Programme in Biotechnology I	
Course Objectives: Student should be able to... 1) explain the use of biotechnology for community benefit. 2) apply knowledge of health, hygiene, and environmental practices. 3) demonstrate social responsibility through community activities. 4) develop effective communication skills.		
Course Outcomes: Students will be able to... 1) apply knowledge in real-life community issues 2) communicate scientific ideas effectively 3) analyse community problems 4) exhibit social responsibility		
Sr No.	Community Engagement Programme in Biotechnology	Hrs
1	Course Type : Field-Based / Extension Activity Duration: 1–2 Weeks Programme Area: Rural/Urban community, schools, NGOs, health centers Activities: Awareness campaigns, biofertilizer awareness, water testing, vaccination awareness Assessment Method: Field Report, Presentation, Participation, Viva Voce	
Evaluation Pattern: 60:40		
Total Marks: 50		
Internal Continuous Evaluation: (20 Marks) Attendance – 10 Marks Scientific activity – 10 Marks		End Semester Examination: (30 Marks) Field Diary – 10 Marks Final Report - 10 Marks Presentation and Viva voce -10 Marks



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester-V

Type : OJT I

Marks: 50

Credits : 4

From: A. Y. 2026-27

Name of the Course: BBTP OJT I: On Job Training in Biotechnology I

Course Objectives: Student should be able to...

- 1) understand biotech work environment.
- 2) apply theoretical knowledge practically.
- 3) develop lab and technical skills.
- 4) improve communication and teamwork.

Course Outcomes: Students will be able to...

- 1) perform basic biotech techniques.
- 2) solve real-world biotech problems.
- 3) analyze and interpret data.
- 4) demonstrate professional skills and ethics.

Sr No.	ON JOB TRAINING	
1	Duration : 4 Weeks Course type: Practical / Skill-Based Training Area: Industry / Research Lab / Hospital / Biotech Company Activities: Lab work, SOP learning, data analysis, report writing Assessment Method: Training Report, Supervisor Evaluation, Viva Voce, Presentation	One month
Evaluation Pattern:60:40		
Total Marks: 100		
Internal Continuous Evaluation: (40 Marks) Attendance – 10 Marks Internship Report – 30 Marks		End Semester Practical Examination: (60 Marks) Presentation – 20Marks Demonstration Skill- 20 Marks Learning Experience and Practical application - 20 Marks



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc

Semester - VI

Type : Major XIII

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBTT 361: Advances in Genetic Engineering

Course Objectives: Student should be able to...

- 1) know basics of gene cloning methodologies, and c-DNA technology..
- 2) understand basics of PCR, types of PCR and Primer designing
- 3) study basics of recombinant DNA technology application.
- 4) learn different molecular markers.

Course Outcomes: Students will be able to...

- 1) discuss PCR-based technologies and their applications.
- 2) describe the molecular markers and applications in research.
- 3) explain application of cloning and recombinant technology.
- 4) elaborate methods of gene transfer

Module	Title and Contents	Hrs
Module -1:	Isolation of Gene: 1.1. Chemical synthesis (Phosphotriester approach, Phosphitetriester approach), Synthesis of complete gene 1.2. cDNA and genomic DNA library 1.3. Screening of libraries- immunological screening and colony or plaque hybridization.	8
Module -2:	PCR and its application: 2.1. Introduction and history of PCR. 2.2. Primer designing , Annealing , Temprature, PCR efficiency , Steps in PCR reaction 2.3. Types of PCR – Inverce PCR, RT PCR, Real time PCR, Nested PCR, Colony PCR, 2.4. Applications, Advantages of PCR, Limitations.	7
Module -3:	Cloning methodologies and Screening of recombinants 3.1. Construction of plasmid (Somatostatin), 3.2. Insertion of foreign DNA into host cells, Agrobacterium-mediated gene transfer, 3.3. chemical methods—CaCl ₂ coprecipitation and polycation-mediated gene transfer. 3.4. Physical methods: Liposomes, microinjection, electroporation, and biolistics. screening or recombinants - Direct selection, Insertional inactivation selection, 3.5. Blue white selection, Fluorescent Activated Cell Sorter	8
Module -4:	Application of r-DNA technology:	7

	4.1. Production of transgenics- Knockout mice 4.2. Gene Silencing- Introduction, Principle of Si-RNA and Si- RNA technology 4.3. Molecular Markers: Types of Marker- Biochemical, Morphological and genetic markers (eg. RFLP, RAPD, AFLP) 4.4. Introduction and principles of CRISPER-Cas - 9	
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Reference Books:-

- 1) Singh, B. D. Biotechnology, Expanding Horizons. 5th ed. New Delhi: Medtech Science Press, 2023.
- 2) Dubey, R. C. Advanced Biotechnology. New Delhi: S. Chand & Company, 2014.
- 3) Nicholl, D. S. T. An Introduction to Genetic Engineering. 3rd ed., South Asian ed. Cambridge: Cambridge University Press, 2010.
- 4) Rastogi, Smita, and Neelam Pathak. Genetic Engineering. New Delhi: Oxford University Press, 2009.
- 5) Howe, C. Gene Cloning and Manipulation. 2nd ed. Cambridge: Cambridge University Press, 2007.
- 6) Lewin, Benjamin. Genes IX. Sudbury, MA: Jones and Bartlett Publishers, 2007.
- 7) Glick, B. R., and J. J. Pasternak. Molecular Biotechnology: Principles and Applications of Recombinant DNA. 3rd ed. Washington, D.C.: American Society for Microbiology, 2002.
- 8) Primrose, Sandy B., Richard Twyman, and Bob Old. Principles of Gene Manipulation: An Introduction to Genetic Engineering. 6th ed. Oxford: Wiley-Blackwell, 2001.
- 9) Sambrook, Joseph, and David Russell. Molecular Cloning: A Laboratory Manual. Vols. I, II, III. 3rd ed. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2000.
- 10) Setlow, Jane K., ed. Genetic Engineering: Principles and Methods. Vol. 13.

Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: (20 Marks)	End Semester Examination: (30 Marks)
CCE I – (10 marks) Home Assignment CCE II- (10 marks) Short long answer questions test/ open book test/ Quiz/ Case Study/ Book Review/ field work/ Industry visit CCE III – (10 marks) MCQ test (Best two out of Three CCE)	Question -1 Question -2 Question -3



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc

Semester - VI

Type : Major XIV

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBTT 362: Food and Microbial Biotechnology

Course Objectives: Student should be able to...

- 1) make students aware of Food Biotechnology.
- 2) understand concepts of microbial biotechnology.
- 3) study the advantages of fermented food products.
- 4) aware the techniques of food preservation for avoid the spoilage and toxicity

Course Outcomes: Students will be able to...

- 1) describe basic concepts of microbial culture mass production.
- 2) discuss give basic Knowledge of fermented food production techniques.
- 3) demonstrate different techniques used for food preservation and avoid toxicity preparation.
- 4) elaborate studied newly prepared genetically modified food analysis for market acceptance.

Module	Title and Contents	Hrs
Module -1:	Microbial Cultures and Production 1.1. Concept of pure and mixed culture, Microbial growth kinetics basic concept (Batch, Continuous and Fed Batch), 1.2. Microbial Production of Enzymes (amylase –koji fermentation), 1.3. Antibiotics (Penicillin), Vitamins (B12), Amino acids (Lysine), Organic acid (Citric acid), Probiotics 1.4. Edible mushroom, commercial cultivation of mushroom, Single Cell Protein (Spirulina)	7
Module -2:	Fermented Foods and Beverages 2.1. Dairy Products – Cheese, Dahi, Yoghurt. Indian Foods – Idli, 2.2. Bakery Products – Bread, Fermented Pickles – Sauerkraut 2.3. Beverages – Beer, Wine (Red table and white table)- Types, Fermentation Process, Aging Process.	7
Module -3:	Food Spoilage, preservation & toxicity: 2.1. Types of spoilage- Physical, Chemical and Biological (auto and microbial) 2.2. Preservation methods: High and Low temperatures, retort process for unrefrigerated storage, Controlled atmosphere and Anerobiosis, Radiations and Asepsis, Chemical preservatives (Salt, sugar, organic acids, SO ₂ , NO ₂) 2.3. Food Toxicity – Mycotoxin (Aflatoxin), Exotoxin (<i>Staphylococcal</i>), Neurotoxin (Botulinum) 2.4. Food borne illness- Shigellosis, Amoebiosis, Aspergillosis.	8
Module -4:	Impact of GM food on human health 4.1. Principle, Risk analysis and Regulations, Multidisciplinary perspectives of GM foods and impact Public health principles,	8

	4.2. Characteristics of food supply for public health, 4.3. Food Safety, Capacity to supply nutritional adequacy, Sustainability, Capacity for Consumer choice, Accessibly and affordability to all.	
Reference Books:- 1) Madigan, Michael T., Kelly S. Bender, Daniel H. Buckley, W. Matthew Sattley, and David A. Stahl. Brock Biology of Microorganisms. 15th ed. Pearson, 2018. 2) Frazier, William C., and Dennis C. Westhoff. Food Microbiology. 5th ed. McGraw Hill Education, 2017. 3) Prescott, Harley, and Klein. Microbiology. 10th ed. McGraw Hill Education, 2017. 4) Lee, Young W., and W. W. Wood. Microbial Biotechnology. Wiley, 2015. 5) Batt, Carl A., and Mary Lou Tortorello. Encyclopedia of Food Microbiology. 2nd ed. Academic Press, 2014. 6) Ray, Bibek, and Arun Bhunia. Fundamental Food Microbiology. 5th ed. CRC Press, 2013. 7) Demain, Arnold L., and Julian E. Davies. Manual of Industrial Microbiology and Biotechnology. 3rd ed. ASM Press, 2009. 8) Montville, Thomas J., and Karl R. Matthews. Food Microbiology: An Introduction. 2nd ed. ASM Press, 2008. 9) Adams, Martin R., and Maurice O. Moss. Food Microbiology. 3rd ed. Royal Society of Chemistry, 2007. 10) Jay, James M., Martin J. Loessner, and David A. Golden. Modern Food Microbiology. 7th ed. Springer, 2005.		
Evaluation Pattern: 60:40		
Total Marks: 50		
Internal Continuous Evaluation: (20 Marks) CCE I – (10 marks) Home Assignment CCE II- (10 marks) Short long answer questions test/ open book test/ Quiz/ Case Study/ Book Review/ field work/ Industry visit CCE III – (10 marks) MCQ test (Best two out of Three CCE)	End Semester Examination: (30 Marks) Question -1 Question -2 Question -3	



Karmaveer Bhaurao Patil University, Satara

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Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc

Semester - VI

Type : Major XV

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBTT 363: Computational Biology

Course Objectives: Student should be able to...

- 1) aware about various bioinformatics tools and techniques.
- 2) understand Concepts of various databases and various methods.
- 3) use bioinformatics tools for the analysis of the biological and Experimental data.
- 4) learn Sequencing techniques and gene annotation

Course Outcomes: Students will be able to...

- 1) understand concepts of various databases and various methods for the data retrieval, data storage, and data mining and use that data for the further analysis.
- 2) discuss in- Silico approach for the protein modelling and drug discovery process.
- 3) Sequencing techniques and gene annotation as well as submission of the sequences to the various databases.
- 4) elaborate various bioinformatics tools and techniques and how to use that for the analysis of the biological experimental data.

Module	Title and Contents	Hrs
Module -1:	Introduction to Bioinformatics 1.1. Introduction to Bioinformatics:-History, Computers in Biology and Medicines, 1.2. Information Resources:- Introduction, aim and objectives, INSDC: International Nucleotide Sequence Database Collection (NCBI, DDBJ, EMBL), Sequence retrieval 1.3. system (SRS): (Entrez, DBGet) 1.4. Genomics:- Human Genome Project (HGP)- Goal and applications, final draft of HGP	8
Module -2:	Protein Sequence Databases 2.1. Proteomics: - Introduction to amino acids and protein, Proteome, Protein structure, 2.2. Primary protein sequence databases- SWISS-PROT, PIR, TrEMBL 2.3. Secondary protein sequence databases: PROSITE, PROFILE, PRINT, 2.4. Other databases: Literature database, PubMed, PubMed central, Protein databank (PDB)	7
Module -3:	Sequence Alignment 3.1. Sequence Alignment:- Introduction, Protein sequence, Nucleic acid sequence, Pair wise sequence alignment, Multiple sequence alignment, Local and Global sequence alignment,	8

	3.2. Algorithm used in sequence alignment, Matrices- Dot matrix, PAM, BLOSSOM. 3.3. Phylogenetic analysis: Introduction: Evolution, definition of phylogenetic tree, nodes, internodes, root, tree, styles; cladogram, phenogram, curvogram, Steps involved in construction of phylogenetic tree	
Module -4:	Application software 4.1. Introduction to MSEXCEL-Use of worksheet to enter data, edit data, copy data move data. Use of in-built statistical functions for computations of Mean, S.D., Correlation, regression coefficients, PCA etc 4.2. Use of bar diagram, histogram, scatter plots, etc. graphical tools in EXCEL for presentation of data. 4.3. Introduction to MSWORD word processor editing, copying, moving, formatting, Table insertion, drawing flow charts etc	7

Reference Books:-

- 1) Lesk, Alan M. Introduction to Bioinformatics. 5th ed. Oxford, UK: Oxford University Press, 2019.
- 2) Kumar, S., Glen Stecher, Michael Li, Claudio Knyaz, and Koichiro Tamura. "MEGA X: Molecular Evolutionary Genetics Analysis across Computing Platforms." Molecular Biology and Evolution 35 (6): 1547–1549, 2018. <https://doi.org/10.1093/molbev/msy096>.
- 3) Tatusova, Tatiana, Sandra Ciufo, Steven Federhen, Boris Fedorov, Robert McVeigh, Kevin O'Neill, and Irina Tolstoy. "Update on RefSeq Microbial Genomes Resources." Nucleic Acids Research 43 (D1): D599–D605, 2015. <https://doi.org/10.1093/nar/gku1062>.
- 4) Benson, David A., M. Cavanaugh, K. Clark, I. Karsch-Mizrachi, J. Ostell, K. D. Pruitt, and E. W. Sayers. "GenBank." Nucleic Acids Research 41 (D1): D36–D42, 2013. <https://doi.org/10.1093/nar/gks1195>.
- 5) Walkenbach, John. Excel 2013 Bible: The Comprehensive Tutorial Resource. Hoboken, NJ: John Wiley & Sons, 2013.
- 6) Felsenstein, Joseph. PHYLIP (Phylogeny Inference Package) Version 3.6. Seattle, WA: Department of Genome Sciences, University of Washington, 2005.
- 7) Mount, David W. Bioinformatics: Sequence and Genome Analysis. 2nd ed. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2004.
- 8) Bairoch, Alain, and Richard Apweiler. "The SWISS-PROT Protein Sequence Database and Its Supplement TrEMBL in 2000." Nucleic Acids Research 28 (1): 45–48, 2000. <https://doi.org/10.1093/nar/28.1.45>.
- 9) Altschul, Stephen F., Thomas L. Madden, Alejandro A. Schäffer, Jianping Zhang, Zhiyong Zhang, Webb Miller, and David J. Lipman. "Gapped BLAST and PSI-BLAST: A New Generation of Protein Database Search Programs." Nucleic Acids Research 25 (17): 3389–3402, 1997. <https://doi.org/10.1093/nar/25.17.3389>.
- 10) Sneath, Peter H. A., and Robert R. Sokal. Numerical Taxonomy: The Principles and Practice of Numerical Classification. San Francisco, CA: W.H. Freeman, 1973.

Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: (20 Marks) CCE I – (10 marks) Home Assignment CCE II- (10 marks) Short long answer questions test/ open book test/ Quiz/ Case Study/ Book Review/ field work/ Industry visit CCE III – (10 marks) MCQ test (Best two out of Three CCE)	End Semester Examination: (30 Marks) Question -1 Question -2 Question -3
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	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology		
	Yashavantrao Chavan Institute of Science, Satara		
	Board of Studies in Biotechnology		
	Programme: B.Sc	Semester - VI	
	Type : Elective I XVI	Marks: 50	
	Credits : 2	From: A. Y. 2026-27	
	Name of the Course: BBTT 364 : Applications of Biotechnology in Agriculture and Health (Elective I)		
Course Objectives: Student should be able to... 1) understand the concept and significance of Somatic Hybridization. 2) study genetic approaches for disease resistance 3) explore modern diagnostic tools 4) study examples of vaccines used in human and veterinary health			
Course Outcomes: Students will be able to ... 1) describe the process of protoplast isolation, fusion, and hybrid selection 2) demonstrate molecular strategies for fungal, bacterial, and viral resistance 3) discuss potential and limitations of gene therapy in medicine 4) explain the concept and advantages of vaccines			
Module	Title and Contents		Hrs
Module -1:	Somatic hybridization 1.1. Artificial Seed and Germplasm preservation , Somatic hybridization- Definition, 1.2. protoplast fusion technique, selection of hybrids, symmetric and asymmetric hybrids, Cybrid production, 1.3. Artificial Seed – Definition, Techniques, factors affecting, applications limitations. 1.4. Germplasm preservation- Introduction, principle, Long term storage, short, medium storage techniques, factors affecting, cryopreservation, applications, limitations.		8
Module -2:	Transgenic Plants 2.1. Herbicide resistant: Glyphosate resistance, Phosphinothricin resistance 2.2. Fungal and Bacterial disease resistance approaches: PR proteins, Chitinase, Glucanase, RIPs proteins, 2.3. Virus resistance: Virus coat proteins, Movement proteins, Trasmission proteins, Satellite RNAs, Antisense RNAs, Ribozymes. 2.4. Insect resistance approaches: BT protein (BT-Cotton, BT-Brijal), Non BT protein, 2.5. Transgenic plant with improved nutrition: Golden Rice, Molecular farming.		7
Module -3:	Monoclonal Antibodies, Biosensor and Gene therapy 3.1. Monoclonal antibodies- Production, Formulation, Applications- Diagnostics & Therapeutic		8

	3.2. Biosensors- Principle & their applications. 3.3. Gene therapy – Introduction and types- Somatic & Germ line gene therapy. 3.4. Current status and future trends in telepathology and digital pathology	
Module -4:	Vaccines- Principle & practice: 4.1. Concept and types of vaccine, preparation of vaccine , Subunit vaccines- Hepatitis B vaccine, Foot and Mouth disease Vaccine, 4.2. DNA Vaccines, Edible Vaccines, 4.3. Recombinant vaccines- Cholera Vaccine, Vaccinia Virus Vaccine.	7
Reference Books:- 1) Satyanarayana, U. Biotechnology. 4th ed. Kolkata: Books and Allied (P) Ltd., 2017. 2) Dubey, R. C. A Textbook of Biotechnology. 5th ed. New Delhi: S. Chand & Company Ltd., 2014. 3) Jogdand, S. N. Advances in Biotechnology. 5th ed. Mumbai: Himalaya Publishing House, 2014. 4) Jogdand, S. N. Medical Biotechnology. 2nd ed. Mumbai: Himalaya Publishing House, 2013. 5) Singh, B. D. Biotechnology. 2nd ed. New Delhi: Kalyani Publishers, 2012. 6) Singh, B. D. A Textbook of Plant Breeding. 2nd ed. New Delhi: Kalyani Publishers, 2011. 7) Chaudhary, R. C. Introduction to Plant Breeding. 1st ed. New Delhi: Oxford & IBH Publishing Co. Pvt. Ltd., 2008. 8) Vyas, S. P., and V. K. Dixit. Pharmaceutical Biotechnology. 1st ed. New Delhi: CBS Publishers & Distributors, 2007. 9) Dubey, R. C. A Textbook of Biotechnology. New Delhi: S. Chand & Company Ltd., 2001. 10) Freshney, Ian. Animal and Cell Biotechnology. New York: Wiley-Liss (John Wiley & Sons), 2000.		
Evaluation Pattern: 60/40		
Total Marks: 50		
Internal Continuous Evaluation: (20 Marks) CCE I – (10 marks) Home Assignment CCE II- (10 marks) Short long answer questions test/ open book test/ Quiz/ Case Study/ Book Review/ field work/ Industry visit CCE III – (10 marks) MCQ test (Best two out of Three CCE)	End Semester Examination: (30 Marks) Question -1 Question -2 Question -3	



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc

Semester - VI

Type : Elective II XVI

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBTT-364 : IPR, Bioethics and Quality Management (Elective II)

Course Objectives: Student should be able to...

- 1) understand the concept of Intellectual Property Rights.
- 2) learn the rules and regulations for patent filing.
- 3) comprehend the dynamic role of entrepreneurship.
- 4) explain quality control and management at the industrial level.

Course Outcomes: Students will be able to...

- 1) familiarize with the rules and regulations related to IPR.
- 2) describe patent laws and filing procedures.
- 3) analyze the fundamentals of management and administration.
- 4) discuss the importance of quality control, management, and industrial safety

Module	Title and Contents	Hrs
Module -1:	General Regime of Intellectual Property Rights: 1.1. Concept of intellectual property; Types of Intellectual Property- Origin and Development- 1.2. An Overview; Intellectual Property Rights as Human Right; 1.3. Role and function of International Institutions- World Intellectual Property Organisation (WIPO) and World trade organization WTO; 1.4. Introduction to copyright; trademark; Geographical Indications and The Protection of Plant Varieties and Farmers' Rights- Farmers rights acts 2001; authority and registry.	8
Module -2:	Patent Law 2.1. Introduction to patent laws - (a) Paris Convention (b) Patent Cooperation Treaty (c) WTO- TRIPS (d) Harmonisation of CBD and TRIPS 2.2. Indian Patent Law- (a) The Patents Act, 1970 (b) Amendments to the Patents Act (c) Patentable Subject Matter, Patentability Criteria (d) 2.3. Procedure for Filing Patent Applications, Patent Granting Procedure (e) Revocation, Patent Infringement and Remedies (f) Relevant Provisions of the Biological Diversity Act, 2002 (g) Access and Benefit Sharing Issues	7
Module -3:	Bioethics and Biotechnology 3.1. Biotechnology and social responsibility, public acceptance issues in biotechnology, issues of access, ownership, monopoly, traditional knowledge, biodiversity, benefit sharing, environmental sustainability, 3.2. public vs private funding, biotechnology in international relations, globalization and development divide.	8

	3.3. Introduction to bioethics: Social and ethical issues in biotechnology. Principles of bioethics. 3.4. Ethical conflicts in biotechnology- interference with nature, unequal distribution of risk and benefits of biotechnology, bioethics vs business ethics.	
Module -4:	Quality management 4.1. Introduction to quality assurance and quality control- Definition, concept Building (premises) for manufacture of drugs, Packaging material, Personnel, hygiene, sanitation, waste and disposal, 4.2. Quality control for: all instruments, clothing's, packing, processing line. 4.3. Quality management- Production Management and Documentation: ICH, ISO 9000 series, total quality management, validation for tablets and parenteral, practice of WHO GMP. 4.4. Industrial Safety: Industrial hazards and their prevention, fire, accidents, mechanical and electrical equipment, industrial effluent testing.	7

Reference Books:-

- 1) Beauchamp, Tom L., and James F. Childress. Principles of Biomedical Ethics. 8th ed. New York: Oxford University Press, 2019.
- 2) Correa, Carlos M. Intellectual Property and the Development of Biotechnology. Cambridge: Cambridge University Press, 2018.
- 3) Slusky, Ronald D. Invention Analysis and Claiming – A Patent Lawyer's Guide. 2nd ed. American Bar Association, 2012.
- 4) Wadehra, B. L. Law Relating to Intellectual Property. 5th ed. Universal Law Publishing Co. Pvt. Ltd., 2011.
- 5) Khurana, R. K., and S. L. Arora. Intellectual Property Rights: Legal and Practical Aspects. New Delhi: Anmol Publications, 2010.
- 6) Ali, Feroz. The Touchstone Effect: The Impact of Pre-grant Opposition on Patents. LexisNexis, 2009.
- 7) Encyclopedia of Bioethics. 5 vol. set. ISBN-10: 0028657748, 2003.
- 8) Ali, Feroz. The Law of Patents. LexisNexis.
- 9) Willing, Sidney H., Murray M. Tuckerman, and Williams Hitchings IV. Good Manufacturing of Pharmaceuticals: A Plan for Total Quality Control. 3rd ed. Bhalani Publishing House, Mumbai.
- 10) World Intellectual Property Organization (WIPO).

Evaluation Pattern: 60/40

Total Marks: 50

Internal Continuous Evaluation: (20 Marks) CCE I – (10 marks) Home Assignment CCE II- (10 marks) Short long answer questions test/ open book test/ Quiz/ Case Study/ Book Review/ field work/ Industry visit CCE III – (10 marks) MCQ test (Best two out of Three CCE)	End Semester Examination: (30 Marks) Question -1 Question -2 Question -3
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Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc

Semester - VI

Type : Major VI

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBTP 365 : Techniques in Advances in Genetic Engineering, Food and Microbial biotechnology and computational Biology

Course Objectives: Student should be able to...

- 1) understand and perform core molecular biology and microbiology techniques (PCR, cloning, transformation, screening).
- 2) develop skills in microbial isolation, bioassays, and food microbiological analysis.
- 3) apply bioinformatics tools for sequence retrieval, similarity analysis, and structural studies.
- 4) enhance data analysis, documentation, and presentation skills using computer applications.

Course Outcomes: Students will be able to...

- 1) perform and interpret molecular techniques like PCR, cloning, and DNA purification.
- 2) isolate, analyze, and evaluate microorganisms and their industrial/biological applications.
- 3) use bioinformatics tools for sequence analysis, BLAST, and phylogenetic studies.
- 4) analyze data and prepare scientific reports using MS Excel and MS Word.

Sr. No.	Name of the Practical	Hrs
1.	DNA Amplification by PCR	60
2.	cDNA cloning by Reverse Transcription PCR	
3.	RAPD analysis	
4.	Bacterial Transformation with Antibiotic & Blue-White Screening	
5.	Purification of DNA fragment from agarose gel	
6.	Isolation of vitamin B12 requiring mutants.	
7.	Bio-assay of Penicillin.	
8.	Microbiological analysis of food products.	
9.	Isolation of lactic acid bacteria from fermented food.	
10.	Antibacterial Activity of Natural Substances (like Garlic or Ginger) Against Common Bacteria	
11.	practical Retrieval and Analysis of Gene and Protein Sequences Using Nucleic Acid and Protein Databases"	
12.	Sequence Similarity Analysis of Nucleotide and Protein Using BLASTn and BLASTp	
13.	Construction of Phylogenetic Tree.	
14.	Analysis of Secondary and tertiary structure of protein using visualizing software Rasmol.	
15.	Introduction to MS Excel and MS Word for Data Analysis and Document Preparation(Draw Graphs, Uses of formula , Tables, Flowcharts)	

Reference Books:-

- 1) Glick, Bernard R., Jack J. Pasternak, and Cheryl L. Patten. Molecular Biotechnology: Principles and Applications of Recombinant DNA. 5th ed. Washington, DC: ASM Press, 2022.
- 2) Lesk, Arthur M. Introduction to Bioinformatics. 5th ed. Oxford: Oxford University Press, 2019.
- 3) Cappuccino, James G., and Natalie Sherman. Microbiology: A Laboratory Manual. 11th ed. Boston: Pearson, 2017.
- 4) Willey, Joanne M., Linda M. Sherwood, and Christopher J. Woolverton. Prescott's Microbiology. 10th ed. New York: McGraw-Hill, 2017.
- 5) Brown, T. A. Gene Cloning and DNA Analysis: An Introduction. 7th ed. Oxford: Wiley-Blackwell, 2016.
- 6) Pevsner, Jonathan. Bioinformatics and Functional Genomics. 3rd ed. Hoboken, NJ: Wiley-Blackwell, 2015.
- 7) Watson, James D., Tania A. Baker, Stephen P. Bell, Alexander Gann, Michael Levine, and Richard Losick. Molecular Biology of the Gene. 7th ed. Boston: Pearson, 2014.
- 8) Frazier, William C., and Dennis C. Westhoff. Food Microbiology. 4th ed. New York: McGraw-Hill, 2008.
- 9) Mount, David W. Bioinformatics: Sequence and Genome Analysis. 2nd ed. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2004.
- 10) Sambrook, Joseph, and David W. Russell. Molecular Cloning: A Laboratory Manual. 3rd ed. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, 2001.

Evaluation Pattern: 60:40**Total Marks: 50****Internal Continuous Evaluation: (20 Marks)**

Student Attendance and Performance –
10Marks
Journal and Viva voce – 10 Marks

End Semester Practical Examination: (30 Marks)

- Question -1
- Question -2
- Question -3



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc.

Semester - VI

Type : (Elective Lab I) II

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBTP 366 : Laboratory exercise in Applications of Biotechnology in Agriculture and Health (Elective Lab I)

Course Objectives: Student should be able to...

- 1) understand basic lab techniques.
- 2) learn microbial isolation & biofertilizer production.
- 3) study plant growth under different conditions.
- 4) gain industrial exposure.

Course Outcomes: Students will be able to...

- 1) perform simple experiments independently.
- 2) isolate microbes like *Azotobacter*.
- 3) analyze effects of stress on plants.
- 4) discuss industrial applications.

Sr. No.	Name of the Practical	Hrs
1.	Estimation of lactic acid of given milk sample.	60
2.	Estimation of fat from given milk sample.	
3.	Analysis of Milk and milk products - MBRT	
4.	Determination of antibacterial activity of crude plant extract.	
5.	Estimation of Fasting and Postprandial Blood Glucose Levels	
6.	Isolation of <i>Azotobacter</i> from soil sample.	
7.	Isolation of <i>Rhizobium</i> from root nodules	
8.	Isolation of PSB from soil.	
9.	Germination/Regeneration Study of Artificial Seeds	
10.	Isolation of <i>Trichoderma</i> / <i>Bacillus thuringensis</i>	
11.	Study of Different Types of Vaccines	
12.	Study the effect of Storage Conditions on Plant Material (Compare growth at room temperature vs refrigeration)	
13.	Study the effect of Light on Plant Growth	
14.	Study the effect of abiotic stress on growth of plant.	
15.	Industrial visit.	

Reference Books:-

- 1) Carson, Sue, Heather B. Miller, D. Scott Witherow, and Melissa C. Srougi. Molecular Biology Techniques: A Classroom Laboratory Manual. 5th ed. Academic Press, 2025.
- 2) Masoodi, Khalid Z., Sameena Maqbool Lone, and Rovidha Saba Rasool. Advanced Methods in Molecular Biology and Biotechnology: A Practical Lab Manual. 2021.
- 3) Jain, Aakanchha, Richa Jain, and Sourabh Jain. Basic Techniques in Biochemistry, Microbiology and

Molecular Biology: Principles and Techniques. New York: Springer, 2020.

- 4) Tripathi, Manoj K., Ashok Ahuja, S. S. Bimal, A. K. Sharma, A. K. Singh, and V. S. Kandalkar. Techniques in Molecular Biology: Practical Manual. Gwalior: RVSKVV, 2020.
- 5) Punia, M. S. Plant Biotechnology and Molecular Biology: A Laboratory Manual. Jodhpur: Scientific Publishers, 2019.
- 6) Das, Surajit, and Hirak Ranjan Dash. Microbial Biotechnology: A Laboratory Manual for Bacterial Systems. New Delhi: Springer, 2015.
- 7) Arora, Dilip Kumar, Surajit Das, and Mesapogu Sukumar, eds. Analyzing Microbes: Manual of Molecular Biology Techniques. Berlin: Springer, 2013.
- 8) Miller, Heather B., D. Scott Witherow, and Sue Carson. Molecular Biology Techniques: A Classroom Laboratory Manual. 3rd ed. Academic Press, 2011.
- 9) Purohit, Sunil D., and Neelu Joshi. Molecular Biology and Biotechnology: A Practical Manual. Udaipur: Apex Publishing House, 2007.
- 10) Surzycki, Stefan. Basic Techniques in Molecular Biology. Berlin: Springer, 2000.

Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: (20 Marks)

Student Attendance and Performance –

10Marks

Journal and Viva voce – 10 Marks

End Semester Practical Examination: (30 Marks)

Question -1

Question -2

Question -3



Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B.Sc

Semester - VI

Type : (Elective Lab II) II

Marks: 50

Credits : 2

From: A. Y. 2026-27

Name of the Course: BBTP 366 : Techniques in Application of Biotechnology in IPR, Bioethics and Quality Management (Elective Lab II)

Course Objectives: Student should be able to...

- 1) understand basics of IPR.
- 2) learn patent search and filing.
- 3) know patent laws and treaties, bioethics and biosafety.
- 4) learn QA/QC and regulations.

Course Outcomes: Students will be able to...

- 1) perform patent search.
- 2) analyze patent case studies.
- 3) apply bioethics and biosafety.
- 4) understand QA/QC and regulatory process.

Sr. No.	Name of the Practical	Hrs
1.	Case Study Analysis on Intellectual Property Types	60
2.	Patent Search Exercise	
3.	Case Study on Biological Patents (Plant, Animal, Microbial)	
4.	Study of Major IPR Treaties and Conventions	
5.	Drafting a Hypothetical Biotechnology Patent	
6.	Comparative Study: Process vs Product Patent (with real case studies)	
7.	Analysis of Biosafety Guidelines for GMO	
8.	Debate: "Should GMOs be Banned?"	
9.	Study of International Conventions on Patenting Biological Materials	
10.	Report on Patenting of Genes, DNA sequences, and Transgenic Organisms	
11.	Documentation and Record-Keeping Practices for Patent Filing in Biotechnology	
12.	Study of Ethical Guidelines in Clinical Trials and Biotech Research	
13.	Quality Assurance (QA) and Quality Control (QC) Practices in Biotech Industries	
14.	Preparation of Material Safety Data Sheet (MSDS) for Biological Products	
15.	Case Study on Regulatory Approval Process for Biotech Products (Drugs/Vaccines)	

Reference Books:-

- 1) Biotechnology Industry Research Assistance Council (BIRAC). 2024. "Empowering Biotech Startups in India." Accessed April 30, 2025. <https://birac.nic.in>.
- 2) Glasman-Deal, Hilary. Science Research Writing for Non-Native Speakers of English. 2nd ed. London: Imperial College Press, 2020.

- 3) Glasman-Deal, Hilary. Science Research Writing for Non-Native Speakers of English. 2nd ed. London: Imperial College Press, 2020.
- 4) Creswell, John W. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. 4th ed. Thousand Oaks, CA: Sage Publications, 2014.
- 5) Creswell, John W. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. 4th ed. Thousand Oaks, CA: Sage Publications, 2014.
- 6) Fowler, Floyd J. Survey Research Methods. 4th ed. Thousand Oaks, CA: Sage Publications, 2009.
- 7) Fowler, Floyd J. Survey Research Methods. 4th ed. Thousand Oaks, CA: Sage Publications, 2009.
- 8) Day, Robert A., and Barbara Gastel. How to Write and Publish a Scientific Paper. 5th ed. Westport, CT: Greenwood Press, 1998.
- 9) Day, Robert A., and Barbara Gastel. How to Write and Publish a Scientific Paper. 5th ed. Westport, CT: Greenwood Press, 1998.
- 10) The Business of Biosciences – What makes a biotech entrepreneur.

Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: (20 Marks) Student Attendance and Performance – 10Marks Journal and Viva voce – 10 Marks	End Semester Practical Examination: (30 Marks) Question -1 Question -2 Question -3
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Karmaveer Bhaurao Patil University, Satara

(A State Public University Est. u/s 3(6) of MPUA 2016)

Faculty of Science and Technology

Yashavantrao Chavan Institute of Science, Satara

Board of Studies in Biotechnology

Programme: B. Sc

Semester - VI

Type : VSC IV

Marks: 50

Credits : 2

From: A. Y. 2025-26

Name of the Course: BBTPVSC IV -Biofertilizer & Biopesticide Technology

Course Objectives: Student should be able to...

- 1) explain the principles of isolation and purification of biofertilizer and biopesticide microorganisms.
- 2) identify beneficial microbes such as *Trichoderma*, *Pseudomonas*, *Bacillus*, *Azotobacter*, and *Rhizobium*.
- 3) apply quality control methods for biofertilizers and biopesticides.
- 4) analyze antimicrobial activity of biopesticides using suitable techniques.

Course Outcomes: Students will be able to...

- 1) explain the role of biofertilizers and biopesticides in sustainable agriculture.
- 2) isolate and identify beneficial microorganisms from soil and plant samples.
- 3) apply laboratory techniques for preparation and formulation of biofertilizers and biopesticides.
- 4) analyze phosphate solubilization and nitrogen-fixing abilities of microorganisms.

Sr. No.	Name of the Practical	Hrs
1.	Bio production of <i>Trichoderma</i> biopesticides	60
2.	Bio production of <i>Pseudomonas</i> biopesticides.	
3.	Isolation and purification of <i>Bacillus</i> biopesticides.	
4.	Quality control of biopesticides	
5.	Study antibacterial activity of biopesticide (agar well diffusion)	
6.	Preparation of plant-based biopesticide (garlic/chili extract)	
7.	Preparation of neem extract as biopesticide	
8.	Isolation and purification of P-solubilizers	
9.	Assessment of Phosphate Solubilization Ability of Microorganisms	
10.	Bio production of <i>Azotobacter</i>	
11.	Estimation of Nitrogen-Fixing Ability (Qualitative Test)	
12.	Bio production of <i>Rhizobium</i>	
13.	Study Mother culture test for Quality Control of Biofertilizer	
14.	Study Broth test for Quality Control of Biofertilizer	
15.	Visit to biopesticides laboratory	

Reference Books:-

- 1) Brown, Alfred E. Benson's Microbiological Applications: Laboratory Manual in General Microbiology. 14th ed. New York: McGraw-Hill Education, 2015.
- 2) Cappuccino, James G., and Natalie Sherman. Microbiology: A Laboratory Manual. 10th ed. Boston: Pearson, 2014.
- 3) Maheswari, Dinesh K. Bacteria in Agrobiolgy. Berlin: Springer, 2012.
- 4) Atlas, Ronald M. Handbook of Microbiological Media. 4th ed. Boca Raton: CRC Press, 2010.

- 5) Atlas, Ronald M. Handbook of Microbiological Media. 4th ed. Boca Raton: CRC Press, 2010.
- 6) Rai, Mahendra K. Handbook of Microbial Biofertilizers. New York: Haworth Press, 2005.
- 7) Kannaiyan, S. Biotechnology of Biofertilizers. New York: McGraw Hill, 2003.
- 8) Aneja, K. R. Experiments in Microbiology, Plant Pathology and Biotechnology. 4th ed. New Delhi: New Age International Publishers, 2003.
- 9) Rangaswami, G., and D. J. Bagyaraj. Agricultural Microbiology. 2nd ed. New Delhi: PHI Learning Pvt. Ltd., 2002.
- 10) Seeley, H. W., Paul J. VanDemark, and John J. Lee. Microbes in Action: A Laboratory Manual of Microbiology. 4th ed. New York: W.H. Freeman, 1991.

Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: (20 Marks) Student Attendance and Performance – 10Marks Journal and Viva voce – 10 Marks	End Semester Practical Examination: (30 Marks) Question -1 Question -2 Question -3
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	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Biotechnology	
	Programme: B.Sc.	Semester - VI
	Type : SEC III	Marks: 50
	Credits : 2	From: A. Y. 2026-27
	Name of the Course: BBTSEC III: Instrumentation And Technique In Biotechnology	

Course Objectives: Students should be able to...

- 1) understand the basic principles and working of common bioinstrumentation tools such as pH meter, spectrophotometer, centrifuge
- 2) develop hands-on skills in handling and operating laboratory instruments safely and accurately .
- 3) learn methods for measurement and analysis of biological samples using different instruments.
- 4) know the importance of calibration, maintenance, and accuracy in laboratory instruments.

Course Outcomes: Students will be able to..

- 1) operate basic bioinstrumentation equipment independently
- 2) perform simple experiments and record accurate observations.
- 3) analyze and interpret experimental data obtained from instruments
- 4) develop laboratory skills, safety awareness, and scientific approach in experimentation .

Sr. No.	Name of the Practical	Hrs
1.	Study and calibration of pH meter	60
2.	Study of conductivity meter and measurement of solution conductivity	
3.	Study and operation of colorimeter for concentration estimation	
4.	Study of UV-Visible spectrophotometer and absorption spectra analysis	
5.	Determination of λ_{max} using UV-Vis spectrophotometer	
6.	Study of centrifuge and separation of biological samples	
7.	Study of microscope (compound microscope) and sample observation	
8.	Study of autoclave and sterilization process	
9.	Study of incubator and its role in microbial growth	
10.	Study of laminar airflow and aseptic	
11.	Study of electrophoresis apparatus (agarose gel electrophoresis)	
12.	Study of colony counter and microbial counting	
13.	Study of BOD incubator and biochemical oxygen demand	
14.	Study of Microtome (Demonstration)	
15.	Instrument Cleaning and Maintenance Practices	

Reference Books:-

- 1) B.D. Singh. Biotechnology: Expanding Horizons – Useful for PCR, ELISA, electrophoresis, and biotech instruments, 2023.
- 2) Douglas A. Skoog, F. James Holler, Stanley R. Crouch. Principles of Instrumental Analysis – Covers spectrophotometry, fluorimetry, electrochemical instruments (pH, conductivity), 2017.

- 3) Bioprocess Engineering Principles. Includes centrifugation, bioreactors, and instrumentation basics, 2012.
- 4) Medical Instrumentation: Application and Design. Useful for blood analyzer and biomedical instruments, 2010.
- 5) Laboratory Manual in Biotechnology. Practical-oriented reference for many lab instruments, 2009.
- 6) Willard, Merritt, Dean & Settle. Instrumental Methods of Analysis – Basic working principles of analytical instruments, 1986.
- 7) Analytical Chemistry. Covers pH meter, conductivity meter, and electrochemical analysis, 1984.
- 8) Environmental Engineering and Science. For DO meter, BOD incubator, turbidity measurement.
- 9) Molecular Cloning: A Laboratory Manual. PCR, electrophoresis, ELISA techniques, 2001.
- 10) Spectrophotometry and Spectrofluorimetry. For UV-Vis spectrophotometer, colorimeter, fluorimeter.

Evaluation Pattern: 60:40

Total Marks: 50

Internal Continuous Evaluation: (20 Marks)

Student Attendance and Performance –
10Marks
Journal and Viva voce – 10 Marks

End Semester Practical Examination: (30 Marks)

Question -1
Question -2
Question -3

	Karmaveer Bhaurao Patil University, Satara (A State Public University Est. u/s 3(6) of MPUA 2016) Faculty of Faculty of Science and Technology	
	Yashavantrao Chavan Institute of Science, Satara	
	Board of Studies in Biotechnology	
	Programme: B.Sc	Semester–VI
	Type : FP I	Marks: 50
	Credits : 2	From: A. Y. 2026-27
Name of the Course: BBTP FP I : Field Project in Biotechnology		
Course Objectives: Student should be able to... 1) apply biotech knowledge in field conditions 2) develop data collection skills 3) analyze real-life problems 4) improve reporting skills		
Course Outcomes: Students will be able to... 1) conduct field-based experiments 2) analyze and interpret data 3) solve field problems 4) present findings effectively		
Sr No.	Field Project in Biotechnology	Hrs
1	Course Type : Field-Based / Project Duration: 1–2 Weeks Field Area: Agriculture, Environment, Health, Industry, Rural/Urban Community Activities: Sample collection, surveys, testing, data analysis, report writing Assessment Method: Project Report, Presentation, Viva Voce	
Evaluation Pattern:60:40		
Total Marks: 50		
Internal Continuous Evaluation: (20 Marks) Attendance – 10 Marks Viva Voce – 10 Marks		End Semester Examination: (30 Marks) Demonstration – 10 Marks Final report – 20 Marks

Co-curricular courses I

AEC IV- English for communication IV